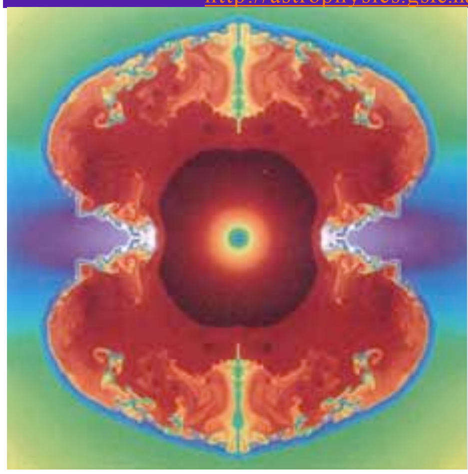
CALCULATING DISTANCE of SN1987A
sn87a_lg.mpg

SUPERNOVA 1987A: 20 YEARS AFTER Supernovae and Gamma-Ray Bursters to be held in:
Aspen, Colorado, from 19 - 23 February 2007
http://astrophysics.gsfc.nasa.gov/conferences/supernova1987a



CALCULATING DISTANCE of SN1987A

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SUMMARY

Views which are taken by Hubble telescop, ESA – ESO at Feb, 1994 for SN 1987A are used for calculating the distance(D) of SN1987A to Earth .Calculations are done for appear diameter ,inclination angle and period from the light curves on milimetric papers by using mathematical toolkit inversions.It's found outside of the ringD = 57,63 kpc inside of the ring

D = 68,59 kpc average of distances:D= 63,11 kpc

A) Calculating from outer part of the ring

1.Step by using mm graphic paper on the image

distance (mm)	distance(arcs)	ratio (arcs / mm)	avarage ratio (arcs / mm)

2. star to 1. star	89	3,0	0,03371	
3. star to 1. star	50	1,4	0,02800	0,03111
3. star to 2. star	136	4,3	0,003162	

2.Step

Appear diameter (a)= 51 mm

a = (51 mm) . (0,03111 arcs / mm) . (4,848 . 10-6 rad / arcs)

a = 4,848 . 10-6 rad / arcs

a = 7,6915 . 10-6 rad

3.Step cos i = near side / hypothenous so;

cos i = small axis/ big axis

cos i = 37 mm / 51 mm

= 0,7591 rad = >

i= 43,49 degree

4.Step by using light –time graph that is given

the day that first light is taken: t1=85,36 days

the day that max light is taken : t2 =451,21 day t= t2 – t1

t1 = 85,36 days t2= 451,21 t= 451,21 – 85,36 = >

t = 365,85 days

5.Step

sin i = dp / d => d = dp / (sin i)

c = light speed(2,977 . 10 8 m/s)

t = day (365,85 . 24 . 60 . 60) = 31609440 seconds

dp = c.t d = dp / (sin i) = (c.t) / (sin i)

d=(2,977 . 108) . (365,85 . 24 . 60 . 60) / sin (43,49)

d = (2977 . 105) . (31609440) / (sin 42,63)

d = 9,41013028815 / 0,68822 . 10-1 =>

(in meters) d = 13,673143 . 1016

6.Step

D = d / a

D = 13,673143 . 1016 / 7,6915 . 10-6

D = 1,7776 . 1022 m = 1,7776 . 1019 km

D = 1,7776 . 1019 / 3,084 . 1013

D = 57,63 kpc

B) Calculating from inner part of the ring

1.Step

	distance (mm)	distance(arcs)	ratio (arcs / mm)	average ratio(arcs / mm)
2. star to 1.star	83	3,0	0,0361	
3. star to 1.star	47	1,4	0,0297	0,0331
3. star to 2. star	128	4,3	0,0335	

2.Step

Appear diameter:(a) = 42 mm
a = (42 mm) . (0,0331 arcs / mm) . (4,848 . 10-6 rad / arcs)

(in radian) a = 6,7396 . 10-6

3.Step

cos i = near side / hypothenous so;

cos i = small axis / big axis

cos i = 31 mm / 43 mm

= 0,0809 rad

i = 41,30 degree

4.Step

the first days that light is taken: 85,36 days

the days that max. light is taken : 451,21 days

t=t2 – t1 t   t1 = 85,36 days   t2 = 451,21 days

t= 451,21 – 85,36

t = 365,85 days

5 .Step

c = speed of light (2,977 . 10 8 m/s)

t = day (365,85 . 24 . 60 . 60) = 31609440seconds

sin i = dp / d => d = dp / (sin i)

dp = c.t

d = dp / (sin i) = (c.t) / (sin i)

d = (2,977 . 108) . (365,85 . 24 . 60 . 60) / sin (41,30)

d = (2977 . 105) . (31609440) / (sin 41,30)

d = 9,41013028815 / 0,660001

d = 14,25775756 . 1017 m

6.Step   D = d / a

D = 14,25775756 . 1017 / 6,7396 . 10-6

D = 21,1551 . 1024 m = 21,1551 . 1021 km

D= 21,1551 . 1021 / 3,084 . 1013

D = 68,59 kpc

CONCULATION:

Distance of SN 1987A to Earth is calculated as 68,59kpc and 57,63 kpc

so the average of two results is taken DISTANCE=63,11 kpc

SOURCES:

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Tales of ...
the history of Supernova 1987A
See image below

February 23, 1987: Canadian astronomer Ian Shelton at Las Campanas Observatory in Chile takes a telescopic photo of a small galaxy over 163,000 light-years from Earth called the Large Magellanic Cloud. For Shelton, it is just routine work — until he develops the photographic plate. On that plate, he notices an extremely bright star, an intruder that he had not seen in previous observations of the same area. He races outside and looks up at the sky. There it is: a star of about the fifth magnitude, glowing in the sky. He realizes that this "new star" is actually an aging massive star that has blown itself apart in a supernova explosion. (The star actually blew up about 161,000 BC, but its light arrived here in 1987.)

Supernova 1987A
A gaseous ring structure surrounds Supernova 1987A

Page: 1 2
... Tales of … Key events in the history of Supernova 1987A (cont'd) ...

Astronomers are excited about this discovery because it is the nearest supernova observed since 1604 — the year Johannes Kepler observed one in our Milky Way galaxy.

Data taken by a small telescope aboard the International Ultraviolet Explorer (IUE) satellite help astronomers identify the exploding star's location as Sanduleak -69° 202, the former site of a blue supergiant about 20 times the mass of the Sun. Astronomers name the exploding star "Supernova 1987A."

Astronomers believe the star swelled up to become a red supergiant, puffed away some mass, then contracted and reheated to become a blue supergiant. Then, in less than a second, the star's core collapsed, and a wave of neutrinos heated the inner core to 10 billion degrees Fahrenheit. This process triggered a shock wave that ripped the star apart, propelling a burst of neutrinos — ghostly particles from the star's core — into space.

The neutrinos are picked up by deep underground detectors: the IMB detector in Ohio and Kamiokande II in Japan. These invisible particles are the first signal of the supernova explosion, arriving even before the bright light from the dying star.

May 1987: By studying the spectrum of the supernova, IUE discovers chemical elements in the supernova debris, which indicate that the progenitor star had already passed through the red giant phase.

July 1987: The Japanese satellite GINGA and a West German X-ray telescope called HEXE, attached to the Soviet Mir space station, detect X-rays coming from the supernova debris.

August to November 1987: Several research missions, including the Solar Maximum Satellite, detect high-energy gamma rays — released in the decay of radioactive elements formed in nuclear reactions at the core of the dying star. The data show that the explosion created from simple building blocks a multitude of chemical elements. Among them was radioactive nickel, which decays into cobalt, which rapidly transforms into stable iron. The discovery confirms a widely-held theory that supernovas produce the heavy chemical elements that make up most things on Earth.

December 1989: Optical observations by the European Southern Observatory's New Technology Telescope in La Silla, Chile show a bright doughnut- or ring-like feature around the supernova.

August 1990: The Faint Object Camera, an instrument aboard the newly deployed Hubble Space Telescope, clearly shows a narrow ring around the supernova. The distance between the ring and the supernova is about three-quarters of a light-year. Some astronomers believe this ring was formed before the supernova explosion, ejected by the blue supergiant star about 20,000 years before it exploded.

1990: Rapidly brightening radio emissions are detected by the Australia Telescope National Facility. (Radio waves were detected for two weeks after the supernova was first spotted.) Astronomers determine that the radio waves are coming from an area that lies between the ring and the glowing debris of the supernova at the center of the ring. In that region, the most rapidly moving debris of the supernova is crashing into gas. Optical telescopes cannot detect the gas because its density is too low and its temperature is too high.

1992: The NASA-Germany ROSAT satellite detects rapidly brightening X-rays from the supernova. The X-rays evidently are coming from the same collision area as the radio waves.

May 1994: The Hubble Space Telescope's Wide Field and Planetary Camera 2 (WFPC2) finds that two outer loops of glowing gas, first identified several years earlier in ground-based images, are surprisingly thin. Puzzled by Hubble's unexpected new details, astronomers are challenged to explain the processes that formed such unusual structures.

January 1997: WFPC2 shows a dumbbell-shaped structure one-tenth of a light-year long. The structure consists of two blobs of debris in the center of the supernova racing away from each other at nearly 6 million miles per hour.

May 1997: The Hubble Space Telescope's Space Telescope Imaging Spectrograph (STIS) produces a detailed ultraviolet image of the inner ring, identifying specific elements such as oxygen, nitrogen, hydrogen, and sulfur. By measuring the ring's composition, astronomers hope to figure out how it was created.

June 1997: Astronomers measure the fast-moving gas ejected by the supernova explosion as it crashes into gas expelled by the progenitor star perhaps 20,000 years before it exploded. This gas was invisible until observed in ultraviolet light by STIS. The spectrograph detects the presence of glowing hydrogen expanding at a speed of 33 million miles per hour.